

Digital pathology and artificial intelligence in translational medicine and clinical practice

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Abstract

Traditional pathology approaches have played an integral role in the delivery of diagnosis, semi-quantitative or qualitative assessment of protein expression, and classification of disease. Technological advances and the increased focus on precision medicine have recently paved the way for the development of digital pathology-based approaches for quantitative pathologic assessments, namely whole slide imaging and artificial intelligence (AI)–based solutions, allowing us to explore and extract information beyond human visual perception. Within the field of immuno-oncology, the application of such methodologies in drug development and translational research have created invaluable opportunities for deciphering complex pathophysiology and the discovery of novel biomarkers and drug targets. With an increasing number of treatment options available for any given disease, practitioners face the growing challenge of selecting the most appropriate treatment for each patient. The ever-increasing utilization of AI-based approaches substantially expands our understanding of the tumor microenvironment, with digital approaches to patient stratification and selection for diagnostic assays supporting the identification of the optimal treatment regimen based on patient profiles. This review provides an overview of the opportunities and limitations around implementing AI-based methods in biomarker discovery and patient selection and discusses how advances in digital pathology and AI should be considered in the current landscape of translational medicine, touching on challenges this technology may face if adopted in clinical settings. The traditional role of pathologists in delivering accurate diagnoses or assessing biomarkers for companion diagnostics may be enhanced in precision, reproducibility, and scale by AI-powered analysis tools.